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Abstract

The main problem in the graph searching theory is to find (in the framework of some formalization) the search number of the graph, i.e., the minimum number of pursuers (searchers) needed "to catch" the invisible evader (the fugitive). In the present paper theorems on search problems with "the counteraction" are surveyed. The counteraction means following: under appropriate conditions the evader can "destroy" a pursuer. At this moment the evader becomes "visible" for pursuers and they may use this information in the future. The problem with the additional condition, when the evader must remove a pursuer at the first opportunity, and the problem with prescribed duration are considered. The sketch of the proof of the result concerning cycles is presented. A chess problem with "the invisible" Black's King is investigated as a graph searching problem under some additional conditions defined by chess rules.

Abstract

In this paper the following scenario is analyzed from a game-theoretical point of view. Two departments in a large organization are each seeking to make an appointment within the same area of expertise, for instance, a computer science specialist. To avoid duplication it has been decided that the heads of the two departments should together interview the applicants in turn and make their decisions on one applicant before interviewing any others. If a candidate is rejected by both departmental heads, the candidate cannot be considered for either post at a later date. If both heads decide to make an offer two cases are considered: (a) the departments are equally attractive so that an applicant has no preference between them (b) one department can offer better prospects to applicants who will always choose that department. The departmental heads know that there are precisely n applicants and that each applicant has an expertise which is random over a known range. If no appointment is made to a department from these n applicants, then the department will suffer from a shortfall of expertise. In the paper it will be shown that that the games (a) and (b) have very different characteristics. The game (b) is straightforward to analyze because it has just one Nash equilibrium. On the other hand, game (a) has many this game has many Nash equilibria and this raises the question of equilibrium selection. We will argue that there are comparatively few natural ones and show that it is reasonable to have several Nash equilibrium solutions as different dynamics within the firm can result in different outcomes. Thus, if one departmental head is aggressive and one passive, we might expect a different outcome to one in which both are of a similar temperament. In the former case we would not necessarily expect a symmetric outcome even though the scenario does not give one player an advantage over the other. Thus, although it may be natural

to expect a solution of (a) to be symmetric, we will also investigate non-symmetric solutions. These non-symmetric equilibria have the advantage that the players have pure actions whereas, in our symmetric solution, the players are called upon to employ actions with complicated probabilities.

Abstract

The paper deals with a generalization of a Prediction Number Game suggested by Sakaguchi and Szajowski (1996) in the case of unsymmetrical conditions. Two players want to guess a realization of a random variable ? whose continuous distribution is known to both of them. The winner is that player who has chosen a value greater than that chosen by his opponent but smaller than the realization of ? (if both players choose a value larger than ? then the game ends in a draw). The player's payoff depends on whether her opponent overestimated the realization of ? or not. Both the obvious zero-sum and nonzero-sum variants of such a game are analyzed. Finally the case is considered when the different payoffs also depend on the player. General results are presented, as well as examples for the case when ? has uniform or exponential distribution. When the payoffs are the same for both players, in the case of zero-sum games, the result describes a unique equilibrium in mixed strategies. For nonzero-sum games, there is a unique Nash equilibrium and both players have the same optimal strategy. A condition for the existence of a Nash equilibrium in the case when each player has specific payoffs is described.

Abstract

A differentiated duopoly where firms produce differentiated but not substitutable goods and invest in research and development (R&D) to reduce their production cost is considered. The objective of this paper is to derive and compare Bertrand and Cournot equilibria. The model is symmetric i.e. all parameters involved in the model are the same for both players. This assumption allows to compare Bertrand and Cournot equilibria in a setting where any difference would be due to the choice of the strategic variables and nothing else. A one stage game is analyzed: firms choose R&D and price (in Bertrand game) or quantity (in Cournot game) at the same time. The general conclusion is that including process R&D as an additional strategic variable in a duopoly game will not change the standard result, namely that Bertrand competition is more efficient than Cournot competition. The result holds true for any positive levels of product differentiation and industry spillover and independently of the form of the investment cost function.

Abstract

Nowadays, certain interest has been shown to the model that describes interaction of two types of the players "predator - prey". In this study, we consider the problem of pursuit for a system with Volterra evolution under the assumption of variable time-delay of information on the evaders behavior. In previous research, it is shown that just as in the case of differential dynamics this problem is equivalent to a certain perfect-information game with some changes both in the dynamics and the terminal set. On the one hand, this equivalence makes it feasible in the case of delayed information to apply the methods, developed for the games with perfect information. In this paper we apply the First Pontryagin Method. On the other hand, on the basis of this equivalence an approach to solution of perfect-information games of pursuit, for which fundamental Pontryagins condition fails, is developed. This approach allow to transform the original game with perfect information to an auxiliary one with special kind information delay and subsequent analysis of the game, equivalent to the latter.

Abstract

Differential game where firms invest to increase the percentage of the product that arrives at destination is proposed. Although several applications of differential games can be found in different fields of industrial organization, and the problem of transport and communication technology research and development (TCRD) investments has never been considered in such a framework. A dynamic model of duopoly with differentiated products where firms compete either in prices or in quantities in a unique market and invest in TCRD is presented. Alternatively, as usual in the international trade literature, one can think of two firms located in different countries that export to a third market. Both open-loop and closed loop Nash equilibria, with attention to closed loop ones are considered. Finally, the solutions emerging from the two market settings against the social optimum are assessed and they are proceeded with a welfare appraisal. This allows one to draw some conclusions on the efficiency of Bertrand and Cournot oligopolies. In particular, in line with the existing literature, it is proved that Bertrand competition yields the socially optimal amount of TCRD effort, while Cournot competition involves excess investment.

Abstract

In the paper, cooperative utility games (TU-games) are investigated. The problem of minimal reduction is investigated for the regularization of dynamic TU-games. This problem is considered in two ways. The first approach is based upon the fact

that to regularize the original game it is natural to remove a coalition from the collection of the disturber players. Developing this approach the notion of conditionally minimal coalition was introduced and investigated. The second approach is based on the observation that the minimal coalition in a general case could be less (in terms of number of players) than the conditionally minimal coalition. Along this line, the acceptable coalitions are discussed. One important problem in dynamic cooperative games is a time-consistency of a solution. In the paper a Davis-Maschler reduced game is modified to a dynamic case to get time-consistent imputations from the core. The paper contains the illustrative example of the practical use of a minimal reduction to provide time-consistency of the imputation from the core of a multistage cooperative TU-game.

Abstract

The conjugate point is a global concept in the calculus of variations. It plays a crucial role to guarantee optimality. Recently, a conjugate point theory was proposed for a minimization problem of a smooth function with n variables, which matches Jacobi's classical conjugate point theory. In either theory, collaboration of variables is essential. Namely, even when a couple of variables cannot improve a solution, collaboration of several variables may find a better solution. If such a set of variables exists, it is called a strict conjugate set. Then a simple question arises. How much does each variable of the strict conjugate set contribute to improve the solution? The aims of this paper are to emphasize a game-theoretic aspect of the conjugate point and to give an answer to the above question. To achieve the aims, a cooperative game based on conjugate sets is defined. It is called the conjugate-set game. Furthermore, the Shapley value for the conjugate-set game is computed.

Abstract

The problem of decision making involving unknown parameters and more than one decision maker in conflict is, generally, considered in the context of the theory of games with incomplete information. In previous study, the concept of NS-equilibrium for a non cooperative n-person game under uncertainty. This concept is based on the concept of Nash equilibrium and the notion of weak Pareto optimal solution of a multiple criteria optimization problem. In this paper, following the Zhukovskiis approach, we introduce the concept of aw- equilibrium for an n-person cooperative strategic game under uncertainty in the case of CI. This concept is a generalization of the concept of ZS-equilibrium. Indeed, in addition to the properties of the ZS-equilibrium, it is stable against the deviation of any coalition of players i.e. if any coalition of players deviates from its strategy in the aw-equilibrium, the remaining players can punish it. We described some properties of the aw-equilibrium and provided sufficient conditions for its existence through the theorem. From the theorem an adequate procedure for the practical determination of this equilibrium for two special classes of games is followed. In future the problem of the existence of aw-equilibrium when the payoff functions are of the general form may be a potential direction of research.

Abstract

A dynamic game model of a bioresource management problem (fisheries) is considered. The center (state) which determines the reserved portion of the reservoir (where fishing is prohibited), and the players (fishing farms) which harvest fish are the participants of the game. Each player is an independent decision maker, guided by the considerations of maximizing the profit from fish sale. We consider finite and infinite planning horizon. Pontryagin's maximal principle and Hamilton-Jacobi-Bellman equation were applied to determine Nash and Stakelberg equlibriums.

Abstract

Let the equilibrium situation exist in some repeated game if the continuous observation for actions of partner is possible. This situation can disappear if the time of possible observation becomes less than the duration of the game. In the paper the situation of equilibrium which is born by the strategies of fixed type is considered. The changes of the set of all such situations are researched when the time of observation is changed from zero to maximum value.

Abstract

The paper examines a game in an extensive form with perfect information in which coalitional structures may change in fixed nodes. Each player makes his decision based on the coalition to which he belongs aiming to maximize its payoff. Using dynamic programming technique, a new solution, the indifferent Nash equilibrium is constructed resulting in the PMS-value. PMS-value is a two-stage solution in which coalitions are acting as individual players using indifferent Nash equilibrium strategies (which are defined in the unique way) and players inside the coalition play cooperatively allocating the common joint payoff according to the Shapley value. A numerical example illustrates theoretical results.

Abstract

In the paper fifteen German elections are analyzed and scrutinized on the occurrence of modified versions of the paradox of redistribution and the paradox of new members. The frequencies of the appearance of these paradoxes are calculated. It is checked how frequently the power indices agree and disagree in the cases in which these paradoxes occur. The frequencies calculated for the German data with the frequencies of the occurrence of the same paradoxes for the Dutch elections (Van Deemen and Rusinowska 2003) are compared.

Abstract

A three-player, sequential-move game with imperfect information is analyzed and the explicit solution is given. This work is the first extension of the present authors recent paper (2003) to the three player games. The solution derived is surprisingly complicate in comparison with the one for the two player game. Our intuition, that the last-mover has an advantage over the middle-mover, and the middle-mover, in turn, has an advantage over the first mover, is proven to correct. Three-player simultaneous-move game is also solved. A conjecture for the solution to the four-player game is given.

Abstract

Bimatrix games provide the simplest models for non-antagonistic interaction of two agents maximizing their personal profits. For this reason the games are of great interest for specialists in the biology, psychology, economics and social sciences. Besides, bimatrix games constitute the basis for more sophisticated models such as iterated games, evolutionary games, cooperative games etc. In the paper the infinitely repeated game based upon a symmetric 2×2 bimatrix game is considered. The strategies of the players having a finite memory are analyzed; the algorithms of finding the Nash equilibria and Stackelberg solutions are suggested.

Abstract

A surplus sharing problem (SSP) is a problem of dividing the proceed of a cooperative venture among several agents. The latters are provided with their (nonnegative) opportunity costs whose sum is less that the total surplus. A surplus sharing method (SSM) associates with every SSP a nonnegative surplus for each agent. The SSMs are characterized by their properties formulated as axioms. There is a nice characterization due to Young (1987) of parametric cost allocation methods which holds also for surplus sharing methods with help of continuity, symmetry, and consistency. In the paper this result is extended to nonsymmetric strict monotonous SSMs. Moreover, the addition of the axioms path independence and strong cost monotonicity gives a characterization of equal gains methods.